CLAIMS

1. A heating apparatus comprising: heating means for heating a substrate to be treated; light intensity detecting means for irradiating visible light or ultraviolet light on the substrate to be treated to detect intensity of reflected light from the substrate; and heating controlling means for controlling heating performed by the heating means on the basis of the detected intensity of reflected light.

2. A heating apparatus comprising: heating means for heating a substrate to be treated; light intensity detecting means for irradiating visible light or ultraviolet light on a plurality of places on the substrate to be treated to detect intensities of reflected lights from the respective places on the substrate; and heating controlling means for controlling heating performed by the heating means on the basis of a plurality of the detected intensities of reflected lights.

3. A heating apparatus according to claim 1, wherein the heating means has an electric heating function and comprises a sample stand on which the substrate to be treated is placed.

4. A heating apparatus according to claim 1, wherein the visible light or the ultraviolet light is light whose band has been narrowed.

5. A heating apparatus according to claim 1,

wherein the light intensity detecting means irradiates light on any place on the substrate to be treated and detects change in film thickness according to composition change or texture change of a resist on the substrate to be treated, which occurs during heating as change in intensity of reflected light.

6. A heating apparatus according to claim 1, wherein the light intensity detecting means irradiates light on an exposure region on the substrate to be treated and detects change in latent image of a resist on the substrate to be treated, which occurs during heating as change in intensity of reflected light.

7. A heating apparatus according to claim 1, wherein the heating controlling apparatus determines the next heating amount on the basis of the accumulated heating amount obtained from the intensity of reflected light or a value obtained by differentiating the accumulated heating amount and controls the heating means to obtain the determined heating amount.

8. A heating apparatus according to claim 7, wherein the heating controlling means controls current while voltage of the heating means is kept constant or controls voltage while current of the heating means is kept constant on the basis of the determined heating amount.

9. A method for evaluating a heating apparatus comprising:

a step for forming a photosensitive resin film on a substrate;

a step for performing exposure on a plurality of exposure regions on the photosensitive resin film in an irradiation amount Dopt;

a step for performing heat treatment on the photosensitive resin film to measure the film thickness of the photosensitive resin film at an unexposed domain adjacent to each exposure region, thereby obtaining a film thickness difference ΔTr between the exposed domain and the unexposed domain; and

a step for obtaining a heating temperature distribution from the film thickness difference ΔTr in each obtained exposure region and a relationship between a film thickness difference ΔTr which has been obtained in advance and heating treating temperature.

10. A method for evaluating a heating apparatus according to claim 9, wherein the irradiation amount Dopt is a value where change amount $\partial \Delta Tr / \partial T$ to temperature of the film thickness difference ΔTr becomes the maximal value or the maximum value.

11. A method for evaluating a heating apparatus/an exposing apparatus, comprising:

a step for forming a photosensitive resin film on a substrate;

a step for applying irradiation amounts Dopt1 and Dopt2 different from each other to a first exposure

portion and a second exposure portion adjacent to each other on a plurality of exposure regions on the photosensitive resin film by one time irradiation;

a step for performing heat treatment on the photosensitive resin film to measure the film thickness of the photosensitive resin film at the first and second exposure portions on each exposure region and an unexposed domain adjacent thereto, thereby obtaining a film thickness difference $\Delta Tr1$ between the first exposure portion in each exposure region and the unexposed domain and a film thickness difference $\Delta Tr2$ between the second exposure portion and the unexposed domain; and

a step for obtaining heating temperature during the heat treatment and a distribution of irradiation amount applied by one time irradiation from the film thickness differences $\Delta Tr1$ and $\Delta Tr2$ in each measured exposure region and a relationship between change in film thickness difference to change of exposing amount which has been obtained in advance and change in film thickness difference to change in treating temperature.

12. A pattern forming method where pattern forming is performed, wherein after adjusting a heating apparatus including:

a step for forming a photosensitive resin film on a substrate;

a step for performing exposure on an exposure

region on the photosensitive resin film in an irradiation amount Dopt;

a step for performing heat treatment on the photosensitive resin film by a heating apparatus to measure the film thickness of the photosensitive resin film at an unexposed domain adjacent to the exposure region, thereby measuring a film thickness difference ΔTr between the exposure region and the unexposed domain;

a step for obtaining heating temperature during the heat treatment from the film thickness difference ΔTr in the measured exposure region and a relationship between a film thickness difference ΔTr which has been obtained in advance and heating treating temperature; and

a step for adjusting the heating apparatus from the obtained heating temperature, and

the method comprising: a step for forming a resist film on a substrate to be treated;

a step for transferring a pattern formed on a projection substrate onto the resist film;

a step for performing heat treatment on the resist film by the heating apparatus; and

a step for applying developing liquid to the resist film to selectively remove a portion of the resist film.

13. A pattern forming method including a step for

forming a resist film on a substrate to be treated;

a step for performing exposure in an exposing amount Dopt to transfer a pattern formed on a projection substrate onto the resist film; and

a step for applying developing liquid to the resist film to selectively remove a portion of the resist film,

wherein, the heat treatment comprises the steps of,

measuring the film thickness of the resist film at an unexposed domain adjacent to the exposure region to measure a film thickness difference ΔTr between the exposure region and the unexposed domain;

obtaining heating temperature from the film thickness difference ΔTr in the measured exposure region and a relationship between a film thickness difference ΔTr which has been obtained in advance and heating treating temperature; and

heating the resist film while the control conditions of the heating apparatus is being adjusted in response to the obtained the heating temperature.

14. A pattern forming method according to claim 12 or 13, wherein the irradiation amount Dopt is a value where change amount $\partial \Delta Tr / \partial T$ to temperature of the film thickness difference ΔTr becomes the maximal value or the maximum value.

15. A pattern forming method wher after adjusting a heating apparatus/exposing apparatus including:

a step for forming a photosensitive resin film on a substrate;

a step for applying irradiation amounts Dopt1 and Dopt2 different from each other to a first exposure portion and a second exposure portion adjacent to each other on an exposure region of the photosensitive resin film with one time irradiation by an exposing apparatus;

a step for performing heat treatment on the photosensitive resin film by a heating apparatus to measure the film thickness of the photosensitive resin film at the first and second exposure portions in the exposure region and the unexposed domain adjacent to the exposure region, thereby measuring a film thickness difference $\Delta Tr1$ between the first exposure portion and the unexposed domain and a film thickness difference $\Delta Tr2$ between the second exposure portion and the unexposed domain;

a step for obtaining heating temperature during the heat treatment and actual irradiation amounts which have been irradiated on the first and second exposure portions from the film thickness differences $\Delta Tr1$ and $\Delta Tr2$ in the measured exposure region and a relationship between change in film thickness difference to change in exposing amount which has been obtained in advance and change in film thickness difference to change to the heating treating

temperature; and

a step for adjusting the heating apparatus/ exposing apparatus from the obtained heating temperature and exposing amount,

wherein the method comprises

a step for forming a resist film on a substrate to be treated;

a step for transferring a pattern formed on the exposure projection substrate onto the resist film;

a step for performing heat treatment on the resist film by the heating apparatus; and

a step for applying developing liquid to the resist film to selectively remove a portion of the resist film.

16. A pattern forming method comprising a step for forming a resist film on a substrate to be treated;

a step for performing exposure on the resist film by an exposing apparatus to transfer a pattern formed on a projection substrate onto the resist film;

a step for performing heat treatment on the resist film by a heating apparatus; and

a step for applying developing liquid to the resist film to selectively remove a portion of the resist film, wherein

the transferring step comprises applying irradiation amounts Dopt1 and Dopt2 different from each other to a first exposure portion and a second exposure

portion adjacent to each other on a monitor region of the resist film, and

the heat treatment step comprises measuring the film thickness of the resist film at the first and second exposure portions and an unexposed domain adjacent thereto on the monitor region to measure a film thickness difference $\Delta Tr1$ between the first exposure portion and the unexposed domain on the monitor region and a film thickness difference $\Delta Tr2$ between the second exposure portion and the unexposed domain;

obtaining heating temperature on the monitor region from the film thickness differences $\Delta Tr1$ and $\Delta Tr2$ on the measured monitor region and a relationship between change in film thickness difference to change in exposing amount which has been obtained in advance and change in film thickness difference to change in treating temperature; and

heating the resist film while the control conditions of the heating apparatus is being adjusted in response to the obtained heating temperature.

17. A heating apparatus according to claim 2, wherein the heating means has an electric heating function and comprises a sample stand on which the substrate to be treated is placed.

18. A heating apparatus according to claim 2, wherein the visible light or the ultraviolet light is

light whose band has been narrowed.

19. A heating apparatus according to claim 2, wherein the light intensity detecting means irradiates light on any place on the substrate to be treated and detects change in film thickness according to composition change or texture change of a resist on the substrate to be treated, which occurs during heating as change in intensity of reflected light.

20. A heating apparatus according to claim 2, wherein the light intensity detecting means irradiates light on an exposure region on the substrate to be treated and detects change in latent image of a resist on the substrate to be treated, which occurs during heating as change in intensity of reflected light.

21. A heating apparatus according to claim 2, wherein the heating controlling apparatus determines the next heating amount on the basis of the accumulated heating amount obtained from the intensity of reflected light or a value obtained by differentiating the accumulated heating amount and controls the heating means to obtain the determined heating amount.

22. A heating apparatus according to claim 21, wherein the heating controlling means controls current while voltage of the heating means is kept constant or controls voltage while current of the heating means is kept constant on the basis of the determined heating amount.

23. A pattern forming method according to claim 13, wherein the irradiation amount Dopt is a value where change amount $\partial \Delta Tr / \partial T$ to temperature of the film thickness difference ΔTr becomes the maximal value or the maximum value.